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Nakano

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(54) **FLUID DISCHARGING DEVICE**

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(51) **Int. Cl.**

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B05C 5/02	(2006.01)
B05B 12/08	(2006.01)
B05B 13/04	(2006.01)

(52) **U.S. Cl.**
CPC ***B05C 5/0279*** (2013.01); ***B05B 12/084*** (2013.01); *B05B 13/041* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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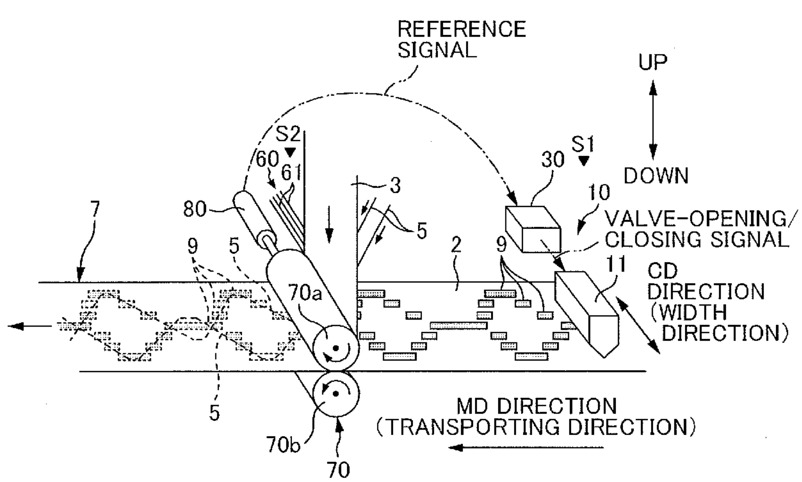
(57) **ABSTRACT**

A fluid discharging device that discharges fluid from a plurality of discharge openings towards a continuous sheet member which is continuously transported in a transporting direction. The fluid discharging device includes: a plurality of valves that correspond to the discharge openings and intermittently discharge the fluid from the discharge openings by opening and closing operations; and a controller that controls the opening and closing operations of each of the valves individually depending on a transportation amount of the continuous sheet member. The controller has a shared adjustment value that is represented by a value indicating the transportation amount, the controller shifts open-close timing of at least several valves of the a plurality of valves from a previously-determined open-close timing that the several valves are subject to, based on the shared adjustment value.

8 Claims, 7 Drawing Sheets



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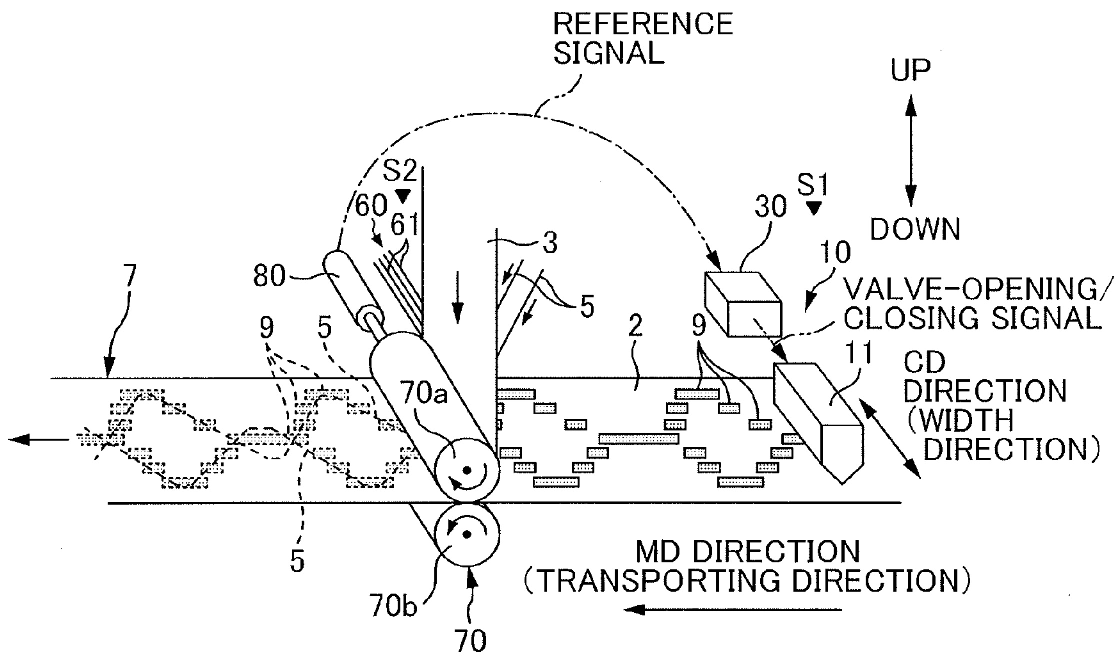

REFERENCE SIGNAL
UP
DOWN
S2
S1
30
60
61
3
80
5
10
VALVE-OPENING/ CLOSING SIGNAL
7
9
2
11
CD DIRECTION (WIDTH DIRECTION)
70a
70b
70
MD DIRECTION (TRANSPORTING DIRECTION)

FIG. 1A

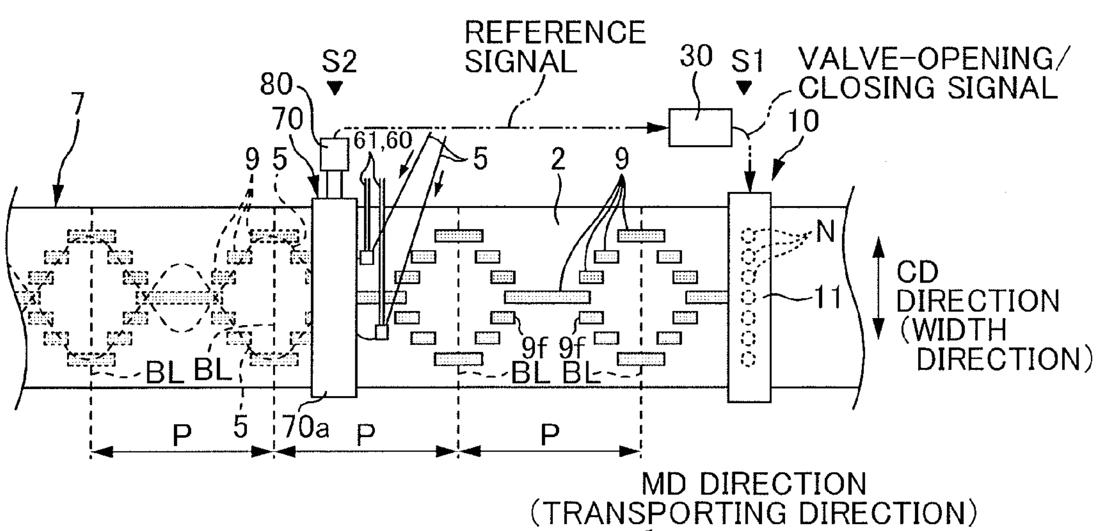

REFERENCE SIGNAL
80
S2
30
S1
VALVE-OPENING/ CLOSING SIGNAL
70
61,60
10
7
9
5
2
N
11
CD DIRECTION (WIDTH DIRECTION)
9f
BL
P
70a
MD DIRECTION (TRANSPORTING DIRECTION)

FIG. 1B

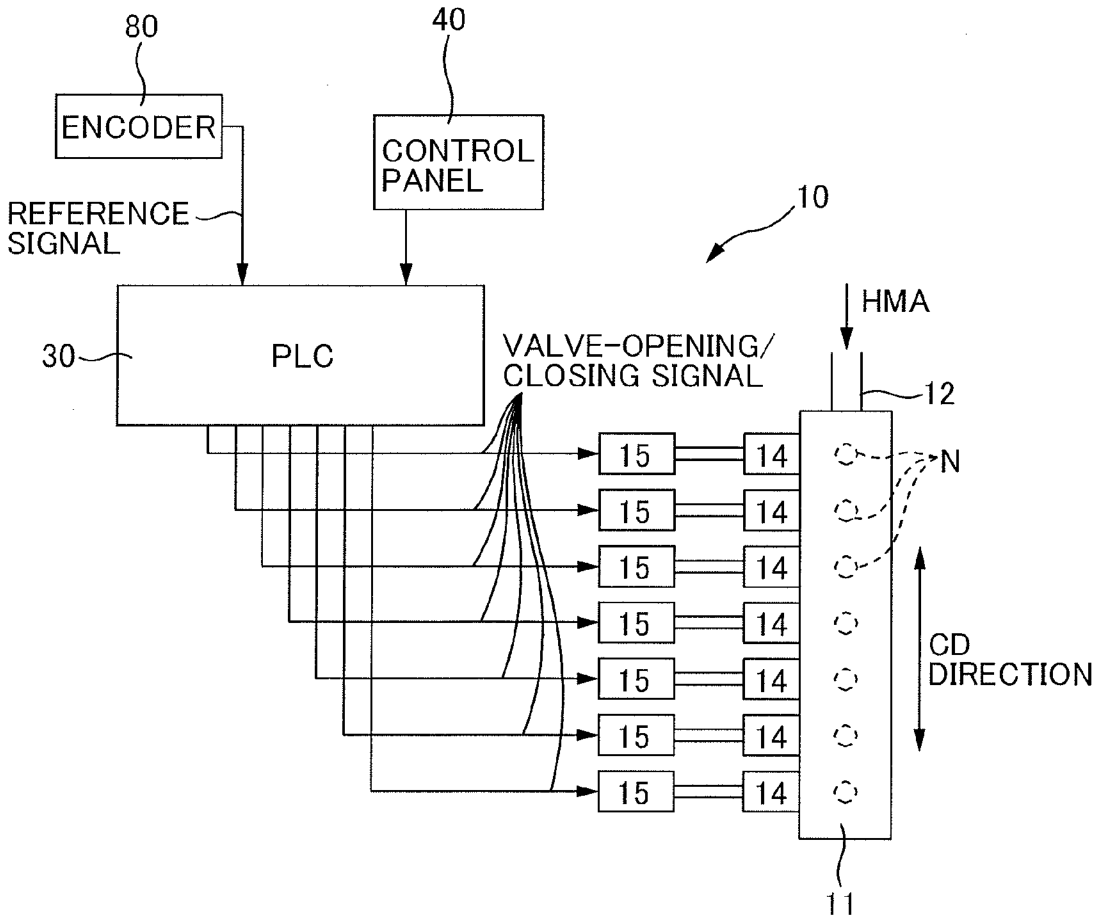
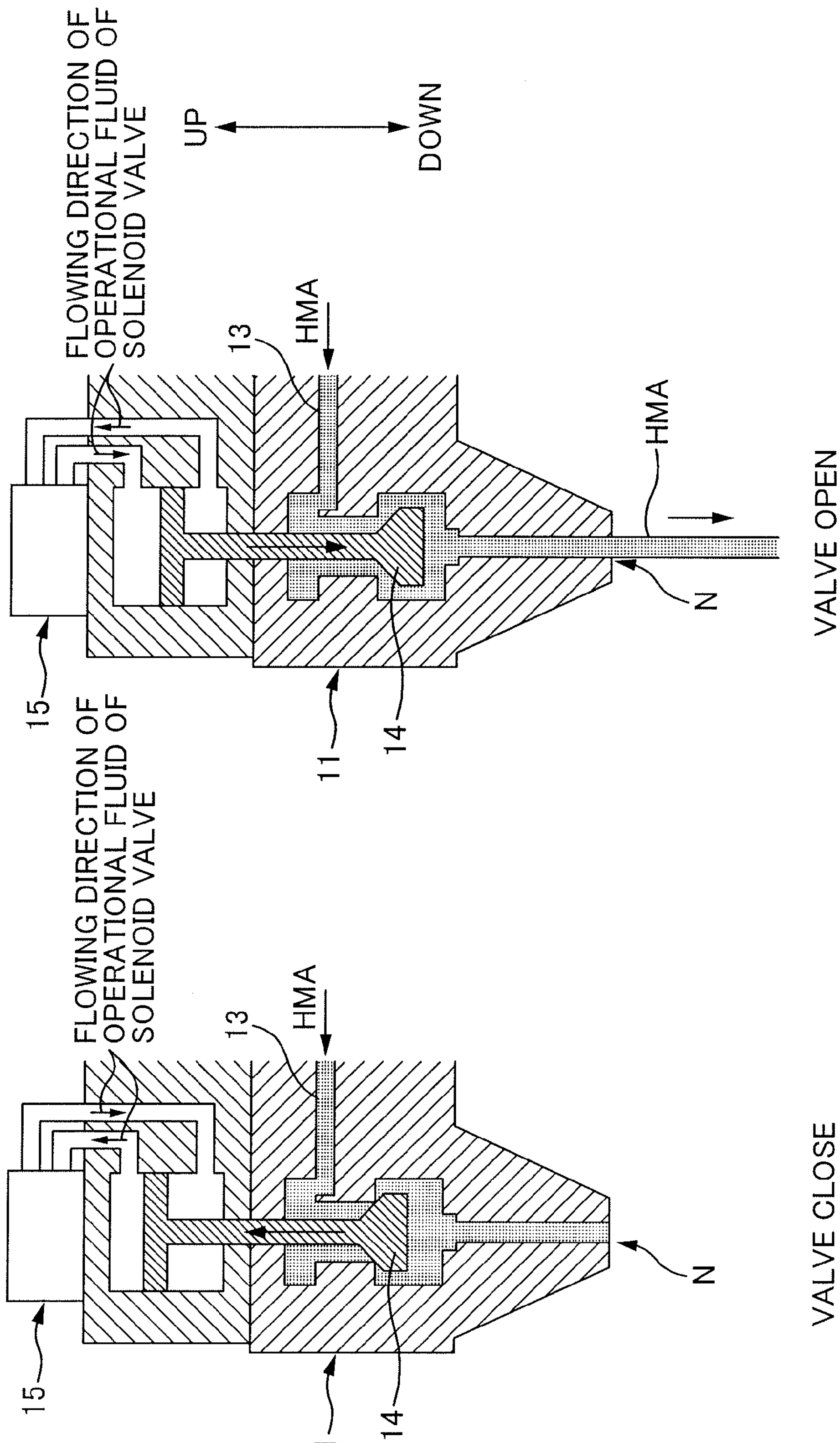

80
ENCODER
40
CONTROL PANEL
REFERENCE SIGNAL
10
HMA
30
PLC
VALVE-OPENING/ CLOSING SIGNAL
12
15
14
N
CD DIRECTION
11

FIG. 2



FLOWING DIRECTION OF OPERATIONAL FLUID OF SOLENOID VALVE
UP
DOWN
HMA
13
HMA
N
VALVE OPEN
15
11
14
FLOWING DIRECTION OF OPERATIONAL FLUID OF SOLENOID VALVE
13
HMA
N
VALVE CLOSE
15
11
14

FIG. 3

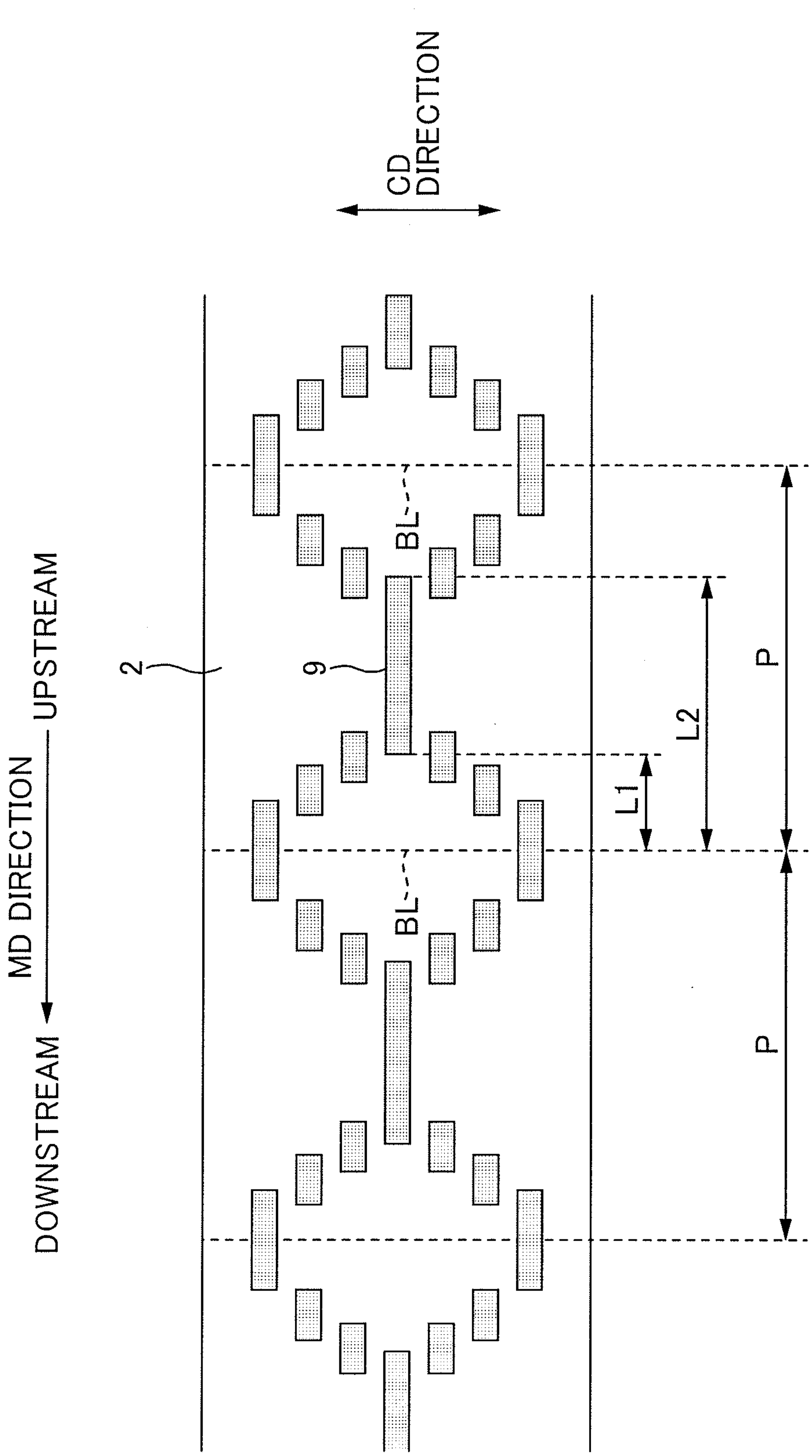
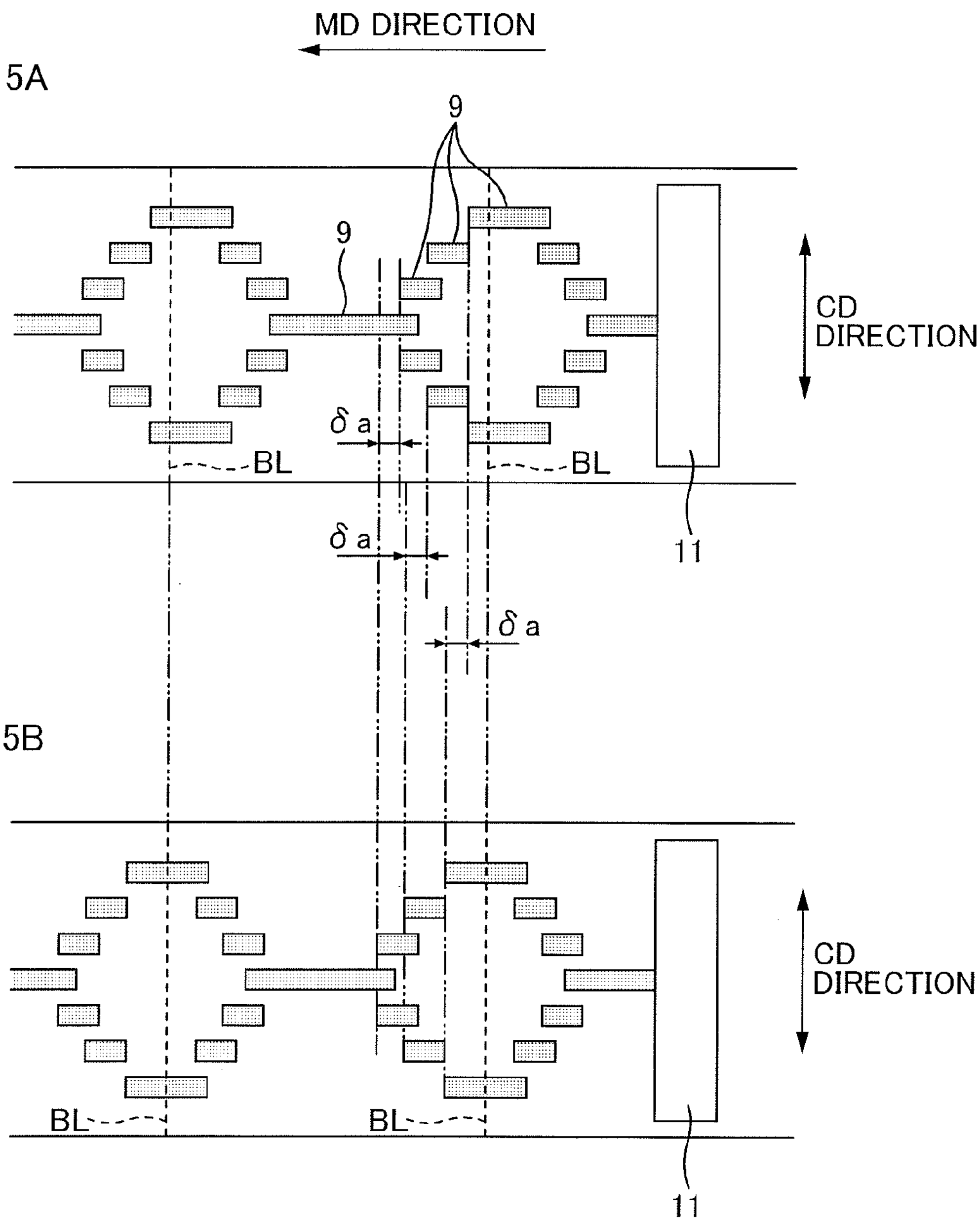

CD DIRECTION
MD DIRECTION
DOWNSTREAM
UPSTREAM
2
9
BL
BL
L1
L2
P
P

FIG. 4

FIG. 5A

FIG. 5B


MD DIRECTION
9
9
CD DIRECTION
δ a
δ a
δ a
BL
BL
11
CD DIRECTION
BL
BL
11

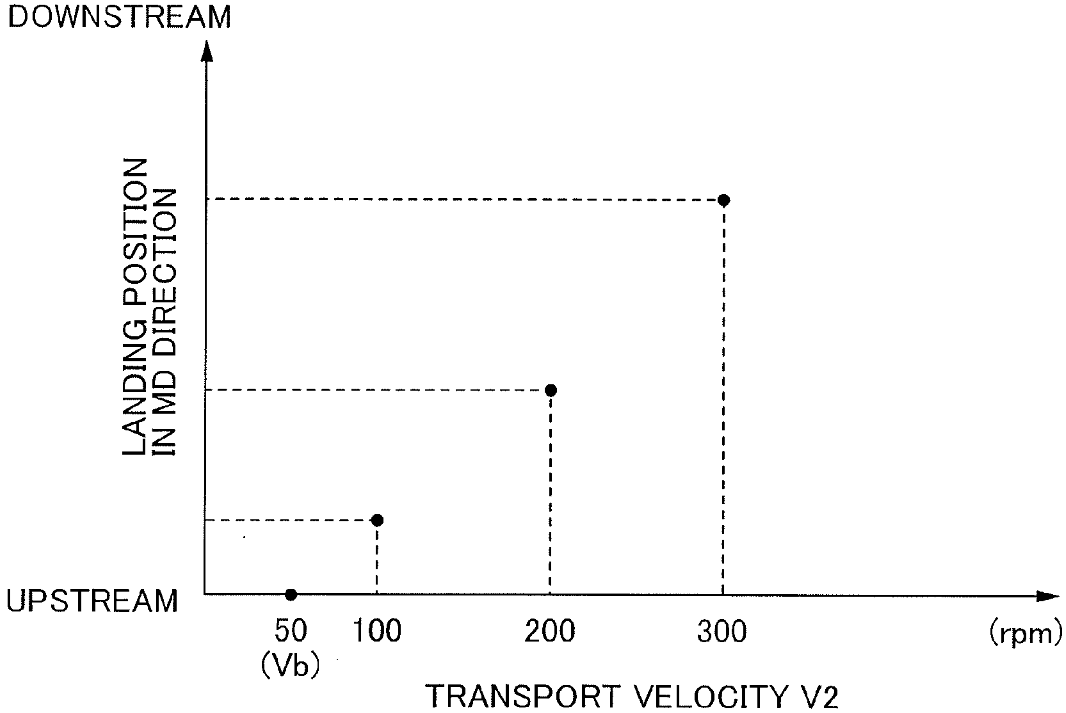

DOWNSTREAM
LANDING POSITION IN MD DIRECTION
UPSTREAM
50 (Vb)
100
200
300
(rpm)
TRANSPORT VELOCITY V2

FIG. 6

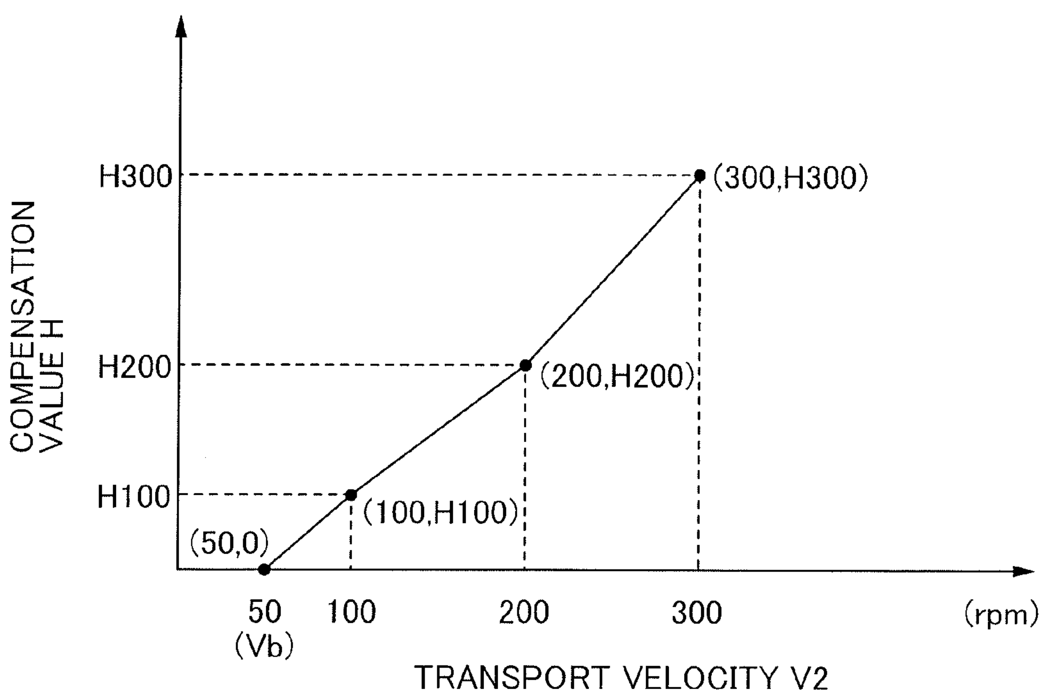

COMPENSATION VALUE H
H300
H200
H100
(300,H300)
(200,H200)
(100,H100)
(50,0)
50 (Vb)
100
200
300
(rpm)
TRANSPORT VELOCITY V2

FIG. 7

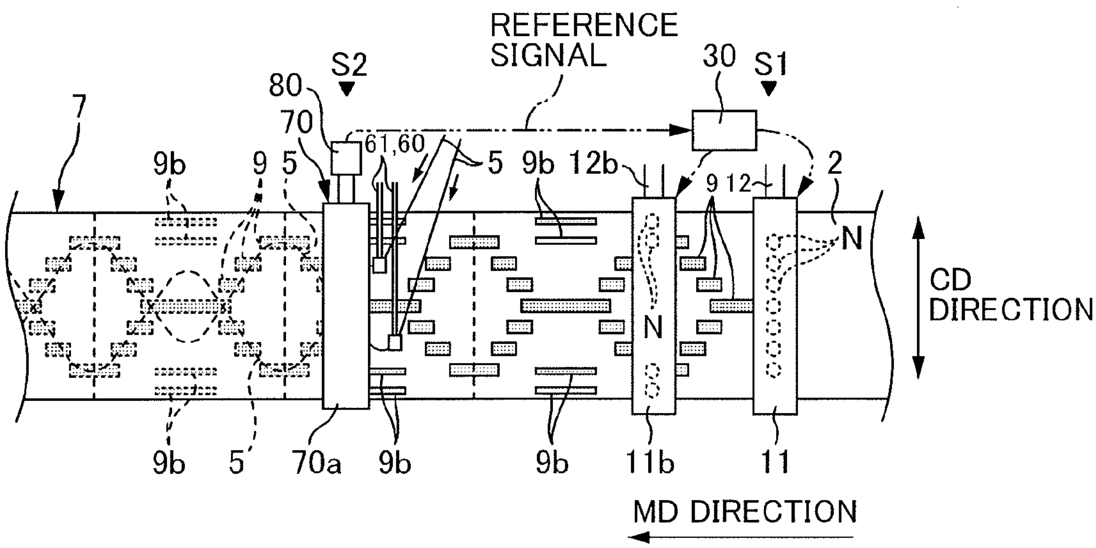

REFERENCE
SIGNAL
30
S1
S2
80
7
70
61,60
5
9b
9
5
9b
12b
9
12
2
N
CD
DIRECTION
N
9b
5'
70a
9b
9b
11b
11
MD DIRECTION

FIG. 8

FLUID DISCHARGING DEVICE

RELATED APPLICATIONS

The present application is a National Phase of International Application Number PCT/JP2010/071636, filed Dec. 3, 2010, and claims priority from Japanese Application Number 2010-003122, filed Jan. 8, 2010.

TECHNICAL FIELD

The invention relates to a fluid discharging device which is used for manufacturing an absorbent article associated with a disposable diaper and the like, the fluid discharging device discharging fluid such as hot-melt adhesive towards a continuous sheet member made of nonwoven fabric and the like.

BACKGROUND ART

Conventionally, in a manufacturing line of disposable diapers and the like, while continuously conveying in a transporting direction a continuous sheet member such as nonwoven fabric and the like, hot-melt adhesive is intermittently applied to the continuous sheet member by discharging the adhesive in the transporting direction ([PTL 1]).

CITATION LIST

Patent Literature

[PTL 1] Japanese Patent Application Laid-open Publication No. 6-237957

SUMMARY OF THE INVENTION

Technical Problem

This intermittent application is performed by a hot-melt adhesive applying device **10** (hereinafter referred to as HMA applying device **10**) (FIGS. **1**A and **1**B). The HMA applying device **10** includes a head **11** which is, for example, arranged at a certain position in the transporting direction, and the head includes a plurality of nozzles N, N . . . lined up in the width direction of a continuous sheet member **2**. Corresponding to each of the nozzles N, one valve **14** (not shown in FIGS. **1**A and **1**B) is disposed. The valves **14** open and close under control of the controller **30** depending on an amount of transportation of the continuous sheet member **2**, and thereby the nozzles N intermittently discharges hot-melt adhesive towards the continuous sheet member **2**.

In order to control opening and closing operations of the valves **14** depending on transportation amount, an encoder **80** is used, for example. The encoder **80** is configured, for example, so as to repeatedly output a digital value from 0 to 8191 during a period in which the continuous sheet member **2** is transported by an amount corresponding to a product pitch P (the length P of one product) of the diaper, the digital value being proportional to the amount by which the continuous sheet member **2** is transported; the product pitch P being defined on the continuous sheet member **2**. The controller **30** controls opening and closing operations of the valves **14** as follows: open the valves **14** when a digital value transmitted from the encoder **80** reaches the predetermined first regulation value; close the valves **14** when the digital value reaches the predetermined second regulation value; and the like. The first regulation value, the second regulation value, etc are set up respectively for the valves **14**.

By the way, a periodic repair work of the manufacturing line or a product change (including changing the size of the product) of a product (diaper) may change the relationship in the transporting direction between the position of the head **11** of the HMA applying device **10** and the position of the encoder **80**. In this case, after the repair work or product change, the actual applying position of hot-melt adhesive may be displaced in the transporting direction from its target position if the hot-melt adhesive is discharged based on the regulation values from before the periodic repair work or product change.

Therefore, when preparing the manufacturing line after the periodic repair work or the product change, an operator of the manufacturing line resets the foregoing regulation values. More specifically, the procedure is as follows. Firstly, while maintaining the foregoing regulation values from before the periodic repair work or product change, hot-melt adhesive is discharged from the head **11** towards the continuous sheet member **2** which is being conveyed at a certain velocity. Then, operator measures the displacement of the actual applying position from the target position of the adhesive on the continuous sheet member **2**. Such values as the foregoing first and second regulation values are then shifted by the amount corresponding to the measured displacement and these shifted values are input to the first and second regulation values. Thereby, the open-close timing of the valves **14** is adjusted.

However, all the valves **14**, **14**, . . . require to be adjusted as mentioned above. This forces the operator to take considerable time and effort.

The invention has been made in view of the above conventional problems, and an advantage thereof is to provided a fluid discharging device which can reduce considerable time and effort to adjust the open-close timing of the valves.

Solution to Problem

An aspect of the invention to achieve the above advantage is

A fluid discharging device that discharges fluid from a plurality of discharge openings towards a continuous sheet member which is continuously transported in a transporting direction, the discharge openings being arranged in a width direction of the continuous sheet member associated with an absorbent article, comprising:

a plurality of valves that correspond to the discharge openings and intermittently discharge the fluid from the discharge openings by opening and closing operations; and

a controller that controls the opening and closing operations of each of the valves individually depending on a transportation amount of the continuous sheet member, wherein

the controller has a shared adjustment value that is represented by a value indicating the transportation amount, and

the controller shifts an open-close timing of at least several valves of the plurality of valves from a previously-determined open-close timing of the several valves, based on the shared adjustment value.

Other features of this invention will become apparent from the description in this specification and the attached drawings.

Effects of the Invention

According to the invention, it is possible to reduce considerable time and effort to adjust the open-close timing of the valves.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a schematic perspective view of a manufacturing line including an HMA applying device **10** according to the first embodiment, and FIG. **1**B is a plan view of the same.

FIG. **2** is a schematic diagram of the configuration of HMA applying device **10**.

FIG. **3** is a longitudinal sectional view of a head **11** of the HMA applying device **10**.

FIG. **4** is a plan view of a continuous sheet member **2**, which is for describing input values of a first regulation value and a second regulation value.

FIGS. **5**A and **5**B are diagrams showing how the application pattern of hot-melt adhesive is formed displaced in its entirety in the MD direction based on an adjustment value Ya.

FIG. **6** is a graph showing a relationship between the transport velocity V2 of the continuous sheet member **2** and a position at which hot-melt adhesive discharged from the head **11** lands on the sheet member in the MD direction.

FIG. **7** is a graph showing a relationship between the transport velocity V2 and a compensation value H which is subject to a compensation according to the second embodiment.

FIG. **8** is a plan view of an HMA applying device **10** according to the third embodiment.

MODE FOR CARRYING OUT THE INVENTION

At least the following matters will be made clear by the description in the present specification and the accompanying drawings.

A fluid discharging device that discharges fluid from a plurality of discharge openings towards a continuous sheet member which is continuously transported in a transporting direction, the discharge openings being arranged in a width direction of the continuous sheet member associated with an absorbent article, comprising:

a plurality of valves that correspond to the discharge openings and intermittently discharge the fluid from the discharge openings by opening and closing operations; and

a controller that controls the opening and closing operations of each of the valves individually depending on a transportation amount of the continuous sheet member, wherein

the controller has a shared adjustment value that is represented by a value indicating the transportation amount, and

the controller shifts an open-close timing of at least several valves of the plurality of valves from a previously-determined open-close timing of the several valves, based on the shared adjustment value.

With such a fluid discharging device, the controller can control the several valves so that the several valves open and close at the timing which is shifted by at least the amount corresponding to the shared adjustment value from the previously-determined open-close timing of the several valves. That is, the open-close timing can be shifted by the amount corresponding to the shared adjustment value at the same time for the several valves. Therefore, it is not necessary to adjust each of the valves individually. This makes it possible to considerably reduce work loads for adjusting the open-close timing of the valves.

In such a fluid discharging device, it is desirable that

the controller calculates a shared compensation value of the opening and closing operations of the several valves based on a transport velocity of the continuous sheet member

the controller shifts the open-close timing of the several valves from the previously-determined open-close timing based on the shared adjustment value and the shared compensation value.

With such a fluid discharging device, when compensating the open-close timing of the valves according to the change of the transport velocity, the shared compensation value is used for the several valves. This makes it possible to reduce an operational load of the controller.

Further, the shared compensation value is used for the several valves. Therefore, the compensation data, such as a compensation-value table, used when obtaining the compensation value does not have to be prepared for each valve. This makes it possible to reduce considerable time and effort to prepare the compensation data.

In such a fluid discharging device, it is desirable that

in the case where

the several valves are defined as a first valve group,

discharge openings corresponding to the valves that belong to the first valve group are defined as a first discharge opening group, and

the shared adjustment value is defined as a first shared adjustment value,

the fluid discharging device further comprises a second discharge opening group that are located on a downstream side of the first discharge opening group in the transporting direction, and

the controller shifts an open-close timing of another plurality of valves from a previously-determined open-close timing of the other plurality of valves, based on a second shared adjustment value, the valves corresponding to discharge openings that belong to the second discharge opening group.

With such a fluid discharging device, the controller can control the other plurality of valves corresponding to the discharge openings that belong to the second discharge opening group so that the other plurality of valves open and close at the timing which is shifted by at least the amount corresponding to the second shared adjustment value from the previously-determined open-close timing of the other plurality of valves. This makes it possible to adjust the open-close timing of the first valve group and the open-close timing of the second valve group independently, resulting in excellent convenience.

In such a fluid discharging device, it is desirable that

the controller has a third shared adjustment value, and

the controller shifts opening/closing timing of a valve that belongs to the first valve group and the second valve group based on the third shared adjustment value, independently of the first shared adjustment value and the second shared adjustment value.

With such a fluid discharging device, the open-close timing can be shifted by the amount corresponding to the third shared adjustment value at the same time for both the first valve group and the second valve group, resulting in excellent convenience.

In such a fluid discharging device, it is desirable that

in the case where

the several valves are defined as a first valve group,

discharge openings corresponding to the valves that belong to the first valve group are defined as a first discharge opening group, and

the shared adjustment value is defined as a first shared adjustment value,

the fluid is supplied to each valve of the first valve group through a shared first supply path,

in the case where

a second supply path is included in addition to the first supply path,

a plurality of valves to which the fluid is supplied through the second supply path is defined as a second valve group, and discharge openings corresponding to the valves that belong to the second valve group are defined as a second discharge opening group,

the controller shifts open-close timing of the valves that belong to the second valve group from a previously-determined open-close timing that the valves are subject to, based on a second shared adjustment value.

With such a fluid discharging device, the open-close timing of each of the supply paths can be adjusted individually. Therefore, the timing can be precisely adjusted, which results in increase of accuracy of the fluid positions in landing on the continuous sheet member. The more detailed description is as follows. In case of the discharge opening groups whose supply paths are different from each other, it is possible that the fluid which flows through each of the paths is different in properties such as viscosity from each other. In this case, the discharge opening groups are different in discharge characteristics of the fluid from each other. As a result, if only one shared adjustment value is used, it is difficult for the fluids which are discharged from different discharge opening groups having their own supply paths to all land on their own predetermined target positions on the continuous sheet member.

On this point, with the foregoing configuration, the shared adjustment value can be set up for each of the supply paths respectively. Therefore, as for the discharge opening groups whose supply paths are different from each other, the landing positions can be adjusted independently. This can increase the accuracy of the fluid positions in landing on the continuous sheet member for both of the discharge opening groups.

In such a fluid discharging device, it is desirable that

the previously-determined open-close timing includes a previously-determined opening timing and a previously-determined closing timing,

the controller includes, for each of the valves,

a first regulation value that sets up the previously-determined opening timing and

a second regulation value that sets up the previously-determined closing timing,

the first regulation value and the second regulation value are represented by the value indicating the transportation amount, and

using the value indicating the transportation amount, the controller controls the opening and closing operations of each of the valves individually depending on the transportation amount.

With such a fluid discharging device, the previously-determined open-close timing can be set up for each of the valves. Therefore, by combining landing marks of fluid discharged towards the continuous sheet member from the discharge openings which respectively correspond to the several valves, any landing pattern of the fluid can be formed on the continuous sheet member.

Further, shifting the open-close timing of the several valves from the previously-determined open-close timing based on the shared adjustment value makes it possible to form the landing pattern which is displaced in the transporting direction of the continuous sheet member while substantially maintaining the shape of the landing pattern without deformation.

First Embodiment

FIG. **1**A is a schematic perspective view of a manufacturing line including a fluid discharging device **10** according to the first embodiment, and FIG. **1**B is a plan view of the same.

On this manufacturing line, a continuous body **7**, which is a half-completed product, is produced. For example, the continuous body **7** includes: a continuous sheet member **2** which serves as a top sheet of a diaper and is made of nonwoven fabric, etc; a continuous sheet member **3** which serves as a back sheet of the diaper and is made of nonwoven fabric, etc; and a pair of rubber threads **5** and **5** which are placed between these sheet members to form leg gathers.

That is, this manufacturing line includes a transporting apparatus (not shown) such as a roll, etc. which continuously conveys the continuous sheet member **2** in a transporting direction, which is the MD direction. On the conveying path, there are the two following sections: an HMA application section S**1** in which hot-melt adhesive (hereinafter also referred to as HMA) is applied to the continuous sheet member **2** in such an application pattern as a pair of approximate sine curves; and a processing section S**2** in which while the rubber threads **5** and **5** being continuously supplied towards an HMA applying area **9** on the continuous sheet member **2**, the continuous sheet member **3** which becomes a back sheet is placed on and bonded to the continuous sheet member **2**.

Hereinafter, a direction perpendicular to the MD direction is referred to as a CD direction; the CD direction is the same as the width direction of the continuous sheet members **2** and **3**.

In the HMA application section S**1**, an HMA applying device **10** is installed. The HMA applying device **10** corresponds to "fluid discharging device" according to the invention, which will be described later.

In the processing section S**2**, there are installed a rubber-thread supply device **60** and pressing rolls **70** which are examples of a processing apparatus. The rubber-thread supply device **60** includes a pair of arms **61** and **61** which moves back and forth in the CD direction while supplying the rubber threads **5** and **5** in the MD direction. While moving back and forth once during a period in which the continuous sheet member **2** is transported by an amount corresponding to a product pitch P in the MD direction, the arms **61** and **61** supply the rubber threads **5** and **5** towards the nip of the pressing rolls **70**. Thereby, the arms **61** and **61** place the rubber threads **5** and **5** on the continuous sheet member **2** in an arrangement pattern such as an approximate sine curve which is similar to the foregoing application pattern.

The pressing rolls **70** have a pair of upper and lower rolls **70***a* and **70***b* which are driven and rotate about an rotational axis pointing in the CD direction. To the nip of them, there are fed not only the foregoing continuous sheet member **2** but also the continuous sheet member **3** which becomes a back sheet. Therefore, the continuous sheet member **2** which becomes a top sheet and the continuous sheet member **3** which becomes a back sheet overlay each other having the rubber threads **5** and **5** between these two sheets **2** and **3**; the threads and the sheets are pinched by the pair of rolls **70***a* and **70***b* and are crimped.

On the continuous sheet member **2** which becomes a top sheet, a layout of a plurality of diapers lined up in the MD direction at the product pitch P is planned. In other words, target positions where such various parts as the rubber threads **5** and **5** will be joined or processed are planned. In the first embodiment, identification of which of the target positions in a diaper corresponds to the portion that is currently being processed by a processing apparatus is performed with reference to the pressing rolls **70**. That is, it is possible to detect in real time which portion of the diaper is currently passing the pressing rolls **70** and which portion is being crimped thereby.

The detection is performed, for example, by a rotary encoder **80** which is disposed of the shaft end of one of the pressing rolls **70** in an integrated manner. Specifically, the encoder **80** outputs one of, for example, 8192 digital values (corresponding to the "value indicating the transportation amount") from 0 to 8191, during a period in which the continuous sheet member **2** is transported by an amount corresponding to the product pitch P, the digital value being proportional to the amount by which the sheet member **2** is transported; and the encoder **80** repeats it. In addition thereto, "0" of the digital values is defined to be associated with the boundary position BL of products adjacent in the MD direction. That is, when the boundary position BL passes through the nip of the pressing rolls **70**, the encoder **80** outputs a digital value "0", and then outputs digital values successively from "1" to "8191" till the next boundary position BL passes.

These digital values are used, for example, as a reference signal for controlling the back-and-forth motion of the arms **61** and **61** of the rubber-thread supply device **60**. That is, the rubber-thread supply device **60** includes: a servomotor (not shown) which moves the arms **61** and **61** back and forth in the CD direction; and a controller (not shown). The controller drives and controls the servomotor based on the digital values that are input from the encoder **80**, and thereby the arms **61** and **61** move back and forth in the CD direction. More specifically, the controller recognizes which portion of the diaper is currently passing the nip of the pressing rolls **70**, based on the digital value of the encoder **80**; simultaneously, the controller causes the rubber threads **5** and **5** to move to and be arranged at the position where in the CD direction the rubber threads **5** are to be joined. Thereby, the rubber threads **5** and **5** are arranged at a position where in the individual product the rubber threads are to be processed. Hereinafter, the digital value is also referred to as a reference signal.

FIG. **2** is a schematic diagram of the configuration of the HMA applying device **10**. This HMA applying device **10** includes a head **11**, a PLC **30** (programmable logic controller) which serves as a controller, and a control panel **40**. The head **11** has a plurality of (for example, 7) nozzles N (corresponding to the "discharge opening") lined up in the CD direction. Also, the head **11** is provided with one supply path **12** which supplies hot-melt adhesive to a flow path in the head **11**. On the downstream side of the supply path **12**, the flow path is divided into branches corresponding to the nozzles N; that is, one branch path **13** (FIG. **3**) is formed for each nozzle N. As shown in the longitudinal sectional view of the head **11** in FIG. **3**, each branch path **13** has a valve **14** which opens and closes the flow path corresponding to the branch path **13**. Each valve **14** has a solenoid valve **15**. To each solenoid valve **15**, valve-opening/closing signal is sent from the PLC **30**, and thereby, the solenoid valve **15** makes the corresponding valve **14** to open and close. The nozzles N intermittently discharge hot-melt adhesive towards the continuous sheet member **2**. Therefore, as shown in FIG. **1**B, band-like applying areas **9** along the MD direction are intermittently formed respectively for the nozzles N.

The PLC **30** sends a valve-opening/closing signal depending on the transportation amount of the continuous sheet member **2**, at a timing which is determined for each of the valves. Therefore, the band-like applying areas **9**, **9** . . . formed by the nozzles N are all combined, resulting in the application pattern in which two approximate sine curves are lined up in the CD direction, as shown in FIG. **1**B.

The valve-opening/closing signals are set, for example, by the control panel **40**. The control panel **40** includes input buttons corresponding to the valves **14** for inputting the first regulation values, the second regulation values and the like, the first regulation values instructing the opening timing and the second regulation values instructing the closing timing of the valves **14**. When a digital value that is input from the encoder **80** reaches the first regulation value, the PLC **30** sends the valve-opening signal to the solenoid valve **15**. Also, when the digital value reaches the second regulation value, the PLC sends the valve-closing signal to the solenoid valve **15**. This makes the valves **14** to open and close.

Input values of the foregoing first regulation values, second regulation values, etc are basically determined based on the product specification of the diaper. FIG. **4** is an explanatory diagram thereof, which is a plan view of the continuous sheet member **2**. The description of the HMA applying area **9** at the center in the CD direction in FIG. **4** will be made below. The following distances are predetermined typically based on the product specification of the diaper: a distance from the downstream end of an HMA applying area **9** to the boundary position BL upstream in the MD direction of the diapers; and a distance from the upstream end of the applying area **9** to the boundary position BL. These distances are respectively referred to as L**1** and L**2**. Basically, the input value of the first regulation value is obtained by the following formula (1), and the input value of second regulation value is obtained by the following formula (2).

$$\text{Input Value of First Regulation Value}=L1/P\times 8192. \tag{1}$$

$$\text{Input Value of Second Regulation Value}=L2/P\times 8192. \tag{2}$$

It should be noted that "P" of the foregoing formulas 1 and 2 is the product pitch P in the MD direction, that is, the total length of a diaper in the MD direction. Also, "8192" of the foregoing formulas 1 and 2 is the number of the digital values (0 to 8191) which the encoder **80** output during a period in which the sheet member **2** is transported by an amount corresponding to the product pitch P.

However, the hot-melt adhesive discharged based on the foregoing input values can land at a target applying area of a diaper precisely if the following relationship is satisfied: the length of the conveying path of the continuous sheet member **2** between the pressing rolls **70** and the nozzles N of the head is an integral multiple of the product pitch P. This is because the digital value of the encoder **80**, which are the reference signal, indicates which of the target positions in a diaper is currently processed at the position of the pressing rolls **70**.

Further, even if the foregoing input values enable hot-melt adhesive to land at the target applying area precisely, it is possible that rearranging units in a periodic repair work of the manufacturing line or changing a product (diaper) causes change of the conveying path length of the continuous sheet member **2** between the pressing rolls **70** and the nozzles N of the head **11**, and that the change causes a displacement of the actual applying area **9** from the target applying area in the MD direction under the condition of using the foregoing input values.

Therefore, each time when preparing the manufacturing line, an operator of the manufacturing line resets the foregoing regulation values. More specifically, the procedure is as follows. Firstly, while maintaining the foregoing regulation values at the same as the values from before the periodic repair work or the product change, hot-melt adhesive is discharged from the head **11** towards the continuous sheet member **2** which is being conveyed at a certain reference velocity Vb. Then, the operator measures the displacement **5** of the actual applying area **9** of the adhesive on the continuous sheet member **2** from the target applying area. The measured displacement δ is converted into digital value of the encoder **80** by the following formula 3, and such values as the foregoing first and second regulation values are shifted by the conversion value Y of the displacement and these shifted values are input to the first and second regulation values. Thereby, the open-close timing of the valves **14** is adjusted.

$$\text{Displacement Conversion Value } Y=5/P\times 8192 \quad (3)$$

However, the foregoing adjustment for all the valves **14**, **14**, . . . requires considerable time and effort. Further, if the cause is change of the conveying path length as mentioned above, the foregoing displacement conversion values Y of all the valves **14**, **14**, . . . should be approximately the same.

Therefore, in the first embodiment, only one of the displacement conversion values Y mentioned above is input as an adjustment value Ya (corresponding to the "shared adjustment value") from the control panel **40**. Then, the PLC **30** executes an operation so that the first and second regulation values are shifted by the adjustment value Ya, these values being associated with all the valves **14**, **14**, . . . of the head **11**. The shifted values, which are the operation results, are stored in a memory of the PLC **30** as a new first regulation value and a new second regulation value. Thereafter, the PLC **30** sends valve-opening/closing signals to the valves **14** based on such values as the new first regulation values and the new second regulation values which are reset respectively for the valves **14**. Therefore, the application pattern of hot-melt adhesive is displaced by a length δa (=Ya/8192×P: corresponding to the adjustment value Ya) while substantially maintaining the shape of the pattern, from the state shown in FIG. **5**A to the state shown in FIG. **5**B.

In order to shift the open-close timing so that the application pattern is displaced downstream in the MD direction (that is, to advance the timing), an adjustment value Ya which is a negative value is added to the first and second regulation values. On the other hand, in order to shift the open-close timing so that the application pattern is displaced upstream (that is, to delay the timing), an adjustment value Ya which is a positive value is added. Whether the timing is advanced or delayed is determined by the displacement relationship in the MD direction between the target applying area and the actual applying area **9**.

Further, in the foregoing example, the instruction values, such as the first regulation value, of the valve-opening/closing signal are shifted at the same time for all the valves **14**, **14**, . . . by the adjustment value Ya; thereby the new first regulation value, etc are determined. However, unlike the foregoing example, the digital value which is output by the encoder **80** may be shifted by the adjustment value Ya. In this case, the PLC **30** compares the first regulation value, the second regulation value, and the like with the digital value which is shifted by the adjustment value Ya. Based on the comparison, the PLC **30** outputs the valve-opening signal and/or the valve-closing signal. In order to shift the open-close timing so that the application pattern is displaced downstream in the MD direction (that is, to advance the timing), an adjustment value Ya which is a positive value is added to the digital value. On the other hand, in order to shift the open-close timing so that the application pattern is displaced upstream (that is, to delay the timing), an adjustment value Ya which is a negative value is added.

Second Embodiment

In addition to the first embodiment mentioned above, the second embodiment includes changing the discharging timing of the hot-melt adhesive (that is, the open-close timing of the valves **14**) according to the transport velocity V2 of the continuous sheet member **2**. The configuration except for this point is almost the same as the first embodiment, the same description will be omitted.

FIG. **6** is a graph showing a relationship between the transport velocity V2 of the continuous sheet member **2** and a position at which hot-melt adhesive discharged from the head **11** lands on the continuous sheet member **2**. As can be seem from FIG. **6**, the landing position is displaced more downstream in the MD direction, as the transport velocity V2 becomes greater. The reason is as follows: because the tips of the nozzles N are opposite the continuous sheet member **2** with a certain spacing, it always takes a certain period of time for hot-melt adhesive that is discharged from the tips of the nozzles N to land on the continuous sheet member **2**; therefore, the continuous sheet member **2** moves greater during the certain time period as the transport velocity V2 becomes greater. Therefore, change of the transport velocity V2 of the continuous sheet member **2** causes variation of the HMA applying areas **9** in the MD direction.

Therefore, in the second embodiment, in order to suppress the variation of the applying areas **9**, the transport velocity V2 is measured in real time. And then, based on the measured value of the transport velocity V2, the PLC **30** performs successively a compensation of the values of the foregoing new first and/or second regulation values. The PLC **30** compares the compensated new first regulation value and new second regulation value with the digital value of the encoder **80**. Based on the comparison, the PLC **30** sends the valve-opening/closing signal to the valves **14**. The foregoing compensation and comparison are repeatedly performed with a control period Tc of a few milliseconds. This enables the PLC to send the valve-opening/closing signal always at an appropriate timing, regardless of the transport velocity V2 which changes gradually. The measured value of the transport velocity V2 is sent instantly to the PLC **30** from a speedometer such as a pulse generator, etc (not shown), the speedometer being included in the vicinity of the pressing rolls **70** or the head **11**.

FIG. **7** is a graph showing a relationship between the transport velocity V2 and a compensation value H which is subject to the foregoing compensation. In this example, the compensation value H is determined as follows: the slowest value of the transport velocity V2 in the manufacturing line is defined as the reference velocity Vb and the compensation value H associated with the reference velocity Vb is set to zero (a so-called reference value), for example. That is, assuming that a landing position at this reference velocity Vb is defined as a reference landing position, the compensation value H associated with various values of the transport velocity V2 are determined based on displacement **61** of the landing position from the reference landing position. Therefore, the foregoing compensation value H is calculated as follows. While actually transporting the continuous sheet member **2**, for example, at a transport velocity V2 to which the corresponding compensation value H has to be obtained, hot-melt adhesive is discharged from the head **11**. Then, the displacement **61** of its landing position from the reference landing position is measured, and the displacement δ**1** in the following formula 4 is substituted.

$$\text{Compensation Value } H=61/P\times 8192 \quad (4)$$

Using the relationship shown in the graph of FIG. **7**, the compensation of the foregoing new first and second regulation values is performed as follows.

Firstly, while successively receiving from the speedometer the transport velocity V2 which is measured in real time, the PLC **30** obtains the compensation value H corresponding to the received value of the transport velocity V2 based on the relationship of FIG. **7**. The obtained compensation value H is subtracted from the foregoing new first and second regulation values. The values after the subtraction becomes the new first and second regulation values, and the first and second regulation values are updated.

It should be noted that, the relationship between the transport velocity V2 and the compensation value H shown in FIG. 7 is stored in the memory of the PLC **30** in a form of a compensation-value table consisting of a plurality of pairs of the transport velocity V2 and the corresponding compensation value H. For example, the compensation-value table can accommodate four data pairs of (V2, H): (50, 0), (100, H100), (200, H200), and (300, H300). A compensation value H corresponding to any value of the transport velocity V2 which is not stored in the compensation-value table is obtained by interpolation using two data pairs among the foregoing four pairs stored in the compensation-value table. For example, if the transport velocity V2 is between 200 (rpm) and 300 (rpm), the compensation value H corresponding to the velocity is obtained by linear interpolation based on the following formula 5.

$$H=(H300-H200)/(300-200)\times(V2-200)+H200 \qquad (5)$$

The compensation-value table mentioned above is prepared for each of the valves **14**. In addition, the table is prepared for each of the opening and closing operations of every valve **14**. The reason the compensation-value table is prepared for each of the opening and closing operations is because the time it takes to open the valve **14** is sometimes different from the time it takes to close the valve **14**.

In the second embodiment, the valves **14** of the nozzles N included in the head **11**, a flow path from the valves **14** to the nozzles N, and the like are configured in the same manner over all the nozzles N, N . . . . In addition thereto, a distance between the continuous sheet member **2** and the tip of each nozzle N is set to the same over all the nozzles N, N . . . . Therefore, as for the operation of discharging hot-melt adhesive based on the valve-opening/closing signal, there is substantially no difference among the nozzles N, N, . . . of the head **11**.

In this case, it is desirable that all the valves **14**, **14**, . . . share the same compensation-value table, not that each of the valves **14** has its own compensation-value table. That is, it is desirable that one compensation-value table for the opening operation and one compensation-value table for the closing operation are included and that this pair of the compensation-value tables are shared by all the valves **14**, **14**, ...

In this case, it is sufficient that, in some cases such as preparing the manufacturing line, an operator obtains the foregoing data of the compensation-value table, that is, the plurality of data pairs (V2, H) mentioned above, for just any one of the valves **14** in the head **11**. This can make the workload it takes for the operator to obtain the data of the compensation-value table considerably smaller than when obtaining the data for every valve.

Further, when the PLC **30** repeats its operations such as compensation with a certain control period Tc as mentioned above, as for the compensation operation it is not necessary to obtain a large number of compensation values H referring to the large number of compensation-value tables. As a result, an operational load of the PLC **30** can be reduced considerably. The more detailed description is as follows. With this method, when the PLC **30** sends the valve-opening signals to the valves **14**, the compensation value H corresponding to the transport velocity V2 from the speedometer is obtained based on one compensation-value table for the opening operation. And then, the compensation value H is defined as a shared compensation value H for all the valves **14**, **14**, . . . , and the compensation value H is subtracted from the new first regulation value of each valve **14**. The compensation for the opening operation is completed. In the same way, when the PLC **30** sends the valve-closing signals to the valves **14**, the compensation value H corresponding to the transport velocity V2 from the speedometer is obtained based on one compensation-value table for the closing operation. And then, the compensation value H is defined as a shared compensation value H for all the valves **14**, **14**, . . . , and the compensation value H is subtracted from the new second regulation value of each valve **14**. The compensation for the closing operation is completed. This makes it possible to reduce the operational load of the PLC **30**.

Third Embodiment

FIG. **8** is a plan view of an HMA applying device **10** according to the third embodiment. In the foregoing first embodiment and second embodiment, the number of the head **11** of the HMA applying device **10** is one. However, in the third embodiment shown in FIG. **8**, two heads **11** and **11***b*, as an example of a plurality of the heads **11**, are arranged and their positions in the MD direction are different. In this example, using the control panel **40**, the foregoing adjustment value Ya can be set up independently for each of the heads **11** and **11***b*.

That is, the PLC **30** can set up the first regulation value, the second regulation value, etc for each of the valves included in the heads **11** and **11***b*; in addition, the adjustment value Ya (corresponding to the "first shared adjustment value" and "second shared adjustment value") can be set up for each of the heads **11** and **11***b*. Therefore, the adjustments of these heads **11** and **11***b* will not affect each other. That is, the open-close timing of the valves **14**, **14**, . . . included in either one of the heads **11** and **11***b* can be shifted at the same time for all of the valves by an amount associated with the adjustment value Ya so that the application pattern is displaced in the MD direction.

In this example, one of the heads, the head **11**, has the same function as the foregoing first and the second embodiment. In other words, the head **11** applies hot-melt adhesive that is for joining the continuous sheet member **2** and the rubber threads **5** and **5**, the rubber threads **5** and **5** forming leg gathers. On the other hand, the other head, the head **11***b*, intermittently forms in the MD direction HMA applying areas **9***b*, **9***b* . . . which is for joining the continuous sheet member **2** and rubber threads (not shown), the rubber threads forming waist gathers, for example.

Further, in this example, the plurality of nozzles N, N . . . included in the head **11** correspond to the "first discharge opening group," and the plurality of valves **14** in the head **11** that are respectively associated with the nozzles N correspond to the "first valve group". On the other hand, the plurality of nozzles N, N . . . included in the head **11***b* correspond to the "second discharge opening group," and the plurality of valves **14**, **14**, . . . in the head **11***b* that are respectively associated with the nozzles N correspond to the "second valve group".

In addition to the foregoing adjustment values Ya for the heads **11** and **11***b*, the PLC **30** may have a shared adjustment value Yc (corresponding to the "third shared adjustment value") which is for shifting the open-close timing by the same amount at the same time for all of the valves **14**, **14**, . . . of these two heads **11** and **11***b* so that the application pattern is displaced in the MD direction. In this case, the discharging timing can be conveniently shifted by the same amount at the same time for all of the valves **14**, **14**, . . . of these two heads **11** and **11***b* so that the application pattern is displaced in the MD direction.

The configuration mentioned above can be achieved in the following manner, etc: the adjustment value Ya and the adjustment value Yc are added to the first regulation value and second regulation value of the foregoing first and second embodiments, the values after the addition are stored by the PLC **30** into the memory as a new first regulation value and a new second regulation value.

By the way, in the third embodiment, as mentioned above, the head **11** located upstream in the MD direction is provided as an example of a unit including the "first discharge opening group" and the "first valve group", and the head **11***b* located downstream is provided as an example of a unit including the "second discharge opening group" and the "second valve group". Also, the configuration in which the units each have their own adjustment value Ya is provided. However, the definition of the units is not limited thereto. For example, the unit may be defined based on the supply path **12** (FIG. **2**) which is for supplying hot-melt adhesive to the flow path in the head **11**. That is, for a different supply path **12**, a different unit may be defined. In this case, it can be said that the controller **30** includes the foregoing adjustment values Ya for each supply path **12** respectively. This configuration has some advantages; for example, it makes it possible to effectively suppress deterioration of the accuracy of the position at which hot-melt adhesive lands on the sheet, which may be caused when the hot-melt adhesive is discharged through the different supply paths **12**. The more detailed description is as follows.

As shown in FIG. **8**, the heads **11** and **11***b* have a different supply path: supply paths **12** and **12***b*. Therefore, it is possible that, depending on any influence such as ambient temperature, the heads **11** and **11***b* are different in properties such as viscosity of the supplied hot-melt adhesive. In this case, between the nozzles N of the head **11** and the nozzles N of the head **11***b*, discharge characteristics such as the discharge speed of hot-melt adhesive and the like are different from each other. As a result, using the same adjustment value Ya for both of the heads **11** and **11***b* makes it difficult for hot-melt adhesives discharged from these heads to land at their own target positions. In other words, while the hot-melt adhesive discharged from either one of the heads **11** and **11***b* can land on its own target position using the adjustment value Ya, the hot-melt adhesive discharged from the other head **11***b* (**11**) cannot.

On this point, if the adjustment values Ya are prepared for each of the supply paths **12** and **12***b* as mentioned above, different adjustment values Ya can be set up between the supply paths **12** and **12***b*. Therefore, the landing positions can be adjusted individually for each of the heads **11** and **11***b* without affecting the adjustments of each other. This makes it possible to increase the accuracy of the landing positions, for both of the heads **11** and **11***b*. In this example, the supply path **12** of the head **11** corresponds to the "first supply path," and the supply path **12***b* of the head **11***b* corresponds to the "second supply path".

Other Embodiments

While the embodiments according to the invention are described above, the invention is not limited to the embodiments and the invention can be altered as described below.

In the first embodiment mentioned above, all the valves **14**, **14**, . . . included in one head **11** share the same adjustment value Ya. However, this invention is not limited thereto. For example, the configuration may be altered so that several of the valves **14**, **14**, . . . are selected from the control panel **40** and the adjustment value Ya is applied only to the selected valves **14**, **14**, ... In other words, the PLC **30** may be configured so that only the first regulation value, etc of the selected valves **14**, **14**, . . . are shifted by the adjustment value Ya.

In the desirable example of the second embodiment mentioned above, all the valves **14**, **14**, . . . included in one head **11** share the pair of the compensation-value tables for the opening and closing operations, and thereby all the valves **14**, **14**, . . . share the pair of shared compensation values for the opening and closing operations. However, this invention is not limited thereto. For example, the configuration may be altered so that several of the valves **14**, **14**, . . . are selected from the control panel **40** and only the selected valves **14**, **14**, . . . is compensated by using the pair of shared compensation values. In other words, the PLC **30** may be configured so that the first and second regulation values of the selected valves **14**, **14**, . . . are each compensated based on the shared compensation value for opening and the shared compensation value for closing respectively.

In the foregoing embodiments, the first and second regulation values are provided as examples. However, as a matter of course, as shown in FIG. **1**B, if there is the valve **14** which forms two applying areas **9***f* and **9***f* along the MD direction in the product pitch P, a third regulation value for the valve-opening signal of that valve **14** is set up and also a fourth regulation value for the valve-closing signal is set up, in addition to the first and second regulation values. It should be noted that in the case of three or more applying areas **9**, **9**, **9** . . . in the MD direction, the number of the regulation values increases accordingly.

In the second embodiment mentioned above, the speedometer is included in order to measure the transport velocity V2 of the continuous sheet member **2**. However, this invention is not limited thereto. For example, it is acceptable that the PLC **30** executes operations based on the following formula 6, thereby the transport velocity V2 is calculated based on the time interval ΔT at which the encoder **80** outputs the digital value. However, in this case, the operational load of the PLC **30** increases. Therefore, the speedometer is preferably included.

$$V2=\Delta D/\Delta T \tag{6}$$

The ΔD in the foregoing formula 6 means an increment ΔD of the transportation amount of the continuous sheet member **2** from the time of output of a certain digital value (e.g., 8190) to the time of output of the next digital value (e.g., 8191), and the ΔD is a known value which each encoder has.

In the foregoing embodiment, a diaper is described as an example of the absorbent article. However, this invention is not limited thereto as long as an article absorbs such exudates as urine, menstrual blood, etc. For example, a sanitary napkin may also be employed.

In the foregoing embodiment, as an example of the encoder **80**, an encoder which outputs a digital value at each rotation through a certain angle is provided. However, this invention is not limited thereto. For example, an encoder which generates a pulse at each rotation through a certain angle and outputs a reset signal at each rotation through the corresponding angle to the product pitch P (e.g. one turn) may be employed. In this case, the PLC **30** counts the number of the pulse output from the encoder, and resets the count to zero each time when receiving a reset signal. Thereby, the encoder cooperates with the PLC **30** and functions in the same manner as the foregoing encoder **80**.

In the foregoing embodiment, the hot-melt adhesive is provided as an example of "fluid". However, the invention is not limited thereto as long as the fluid is a fluid such as a liquid or a gel having a sufficient flowability to be intermittently discharged towards the continuous sheet member **2** associated with an absorbent article. Another type of adhesive may be employed, and any fluid other than adhesive may also be employed.

In the foregoing embodiment, the non-contact discharge opening in which the tip of nozzle N, serving as a discharge opening, is not in contact with the continuous sheet member **2** is described. That is, the tip of the nozzle N is positioned with a spacing between the continuous sheet member **2**. However, the invention is not limited thereto. A contact discharge opening may be employed. In other words, the tip of the nozzle N or a member disposed on the tip may be in contact with the continuous sheet member **2**. As an example of the contact discharge opening, the following configuration can be provided: the tip of the nozzle N is provided with a sphere which can rotate like a ball of a ballpoint pen, the sphere is moved by keeping in contact with the continuous sheet member **2**. In the case of this contact discharge opening, hot-melt adhesive does not fly through a space between the tip of the nozzle N and the continuous sheet member **2** when being discharged. Therefore, without the foregoing compensation of the transport velocity V2 according to the second embodiment, the accuracy of the landing position of the adhesive can be achieved in some degree.

In the third embodiment mentioned above, the configuration including two heads **11** and **11***b* are provided as an example of a plurality of the heads **11**. However, the number of the heads is not limited to two. Another head may be placed at a different position in the MD direction in the manufacturing line. As a matter of course, in this case, each head may have its own adjustment value Ya in the same manner as the third embodiment. Depending on the case, the adjustment value Ya may be shared by all of the heads **11**, **11***b*, ... With such a configuration, by inputting a single adjustment value Ya, the discharging timing can be shifted by the same amount at the same time for all the valves **14**, **14**, . . . included in all the heads **11**, **11***b*, . . . so that the application pattern is displaced in the MD direction.

In the foregoing embodiment, the nozzles N correspond to the valves **14** respectively. However, this invention is not limited thereto. For example, a plurality of nozzles N may correspond to one of the valves.

REFERENCE SIGNS LIST

2 continuous sheet member for top sheet (continuous sheet member),
3 continuous sheet member for back sheet,
5 rubber thread,
7 continuous body of half-completed product,
9 applying area, **9***b* applying area, **9***f* applying area,
10 HMA applying device (fluid discharging device),
11 head, **11***b* head,
12 supply path (first supply path), **12***b* supply path (second supply path),
13 branch path,
14 valve,
15 solenoid valve,
30 PLC (controller),
40 control panel,
60 rubber-thread supply device,
61 arm,
70 pressing roller, **70***a* roll, **70***b* roll,
80 rotary encoder,
N nozzle (discharge opening),
BL boundary position,
S1 HMA application section, **S2** processing section

The invention claimed is:

1. A fluid discharging device configured to discharge fluid from a plurality of nozzles towards a continuous sheet member which is continuously transported in a transporting direction, the nozzles being arranged in a width direction of the continuous sheet member for an absorbent article, said fluid discharging device comprising:

a head having the plurality of nozzles and a plurality of valves corresponding to the plurality of nozzles, said plurality of valves being configured to intermittently discharge the fluid in a predetermined pattern on the continuous sheet member from the plurality of nozzles by opening and closing operations;

a controller coupled to the head;

a control panel coupled to the controller; and

an encoder coupled to the controller,

wherein

the head has a supply path and a flow path downstream of the supply path,

the head is configured to receive the fluid from the supply path,

the flow path is divided into branch paths corresponding to the respective nozzles and the respective valves,

the control panel is configured to input a displacement conversion value Ya for all of the plurality of valves,

the controller is configured to

set, for each of the valves,

a first regulation value setting up an opening timing of said valve, and

a second regulation value setting up a closing timing of said valve, the first and second regulation values corresponding to a value indicating a transportation amount of the continuous sheet member,

control the opening and closing operations of each of the valves individually depending on the transportation amount of the continuous sheet member, and

calculate a shared adjustment value based on the displacement conversion value Ya inputted through the control panel amount, the shared adjustment value corresponding to the value indicating the transportation amount, and the shared adjustment value being shared by all of the plurality of valves, and

shift the first regulation value and the second regulation value for all of the plurality of valves by the shared adjustment value,

wherein the controller is configured to cause the predetermined pattern of the discharged fluid to be displaced by a length δa while maintaining a shape of the predetermined pattern, the length δa being defined by a formula $\delta a = Ya/Nd$, where Nd is a number of digital values which the encoder is configured to output during a period in which the continuous sheet member is transported by an amount corresponding to a product pitch.

2. The fluid discharging device according to claim **1**, wherein

the controller is configured to calculate a shared compensation value of the opening and closing operations of all of the valves based on a transport velocity of the continuous sheet member, and

the controller is configured to shift the first regulation value and the second regulation value for all of the plurality of valves by the shared adjustment value and the shared compensation value.

3. The fluid discharging device according to claim **1**, wherein

said plurality of valves defines a first valve group,

the nozzles corresponding to the valves that belong to the first valve group define a first nozzle group,

the shared adjustment value defines a first shared adjustment value,

the fluid discharging device further comprises:

a second valve group including a plurality of valves,

a second nozzle group including nozzles corresponding to the plurality of valves that belong to the second valve group, the second nozzle group being located on a downstream side of the first nozzle group in the transporting direction, and

the controller is configured to shift an opening timing and a closing timing of all of the plurality of valves in the second valve group by a second shared adjustment value.

4. The fluid discharging device according to claim **3**, wherein

the controller is configured to calculate a third shared adjustment value, and

the controller is configured to shift the opening timing and the closing timing of the valves that belong to the first valve group and the second valve group based on the third shared adjustment value, independently of the first shared adjustment value and the second shared adjustment value.

5. The fluid discharging device according to claim **1**, wherein

said plurality of valves defines a first valve group,

the nozzles corresponding to the valves that belong to the first valve group define a first nozzle group,

the shared adjustment value defines a first shared adjustment value,

each of the valves of the first valve group is configured to receive the fluid from the supply path which defines a shared first supply path,

the fluid discharging device further comprises:

a second valve group including a plurality of valves each configured to receive the fluid from a second supply path,

a second nozzle group including nozzles corresponding to the valves that belong to the second valve group, and

the controller is configured to shift an opening timing and a closing timing of all of the plurality of valves in the second valve group by a second shared adjustment value.

6. The fluid discharging device according to claim **1**, wherein

when the shared adjustment value is a negative value, the controller is configured to add the negative value to the first and second regulation values to advance the corresponding opening and closing timings for all of the valves, and

when the shared adjustment value is a positive value, the controller is configured to add the positive value to the first and second regulation values to delay the corresponding opening and closing timings for all of the valves.

7. The fluid discharging device according to claim **2**, wherein the controller is configured to subtract the shared adjustment value from the first and second regulation values to obtain new first and second regulation values for shifting the corresponding opening and closing timings for all of the valves.

8. The fluid discharging device according to claim **2**, wherein the controller is configured to

set a landing position of the fluid on the continuous sheet member at a reference transport velocity of the continuous sheet member as a reference landing position, and

determine the shared adjustment value associated with various values of the transportation amount of the continuous sheet member based on a displacement of another landing position from the reference landing position.

* * * * *